

Simpson[®]

INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

SIMPSON 360-3
DIGITAL MULTIMETER

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.

SIMPSON ELECTRIC COMPANY

A Katy Industries, Inc. Subsidiary

853 Dundee Avenue, Elgin, Illinois 60120

(312) 697-2260 • Cable SIMELCO • Telex 72-2416

IN CANADA: Bach Simpson, Ltd., London, Ontario

IN ENGLAND: Bach-Simpson (U.K.) Ltd., Wadebridge, Cornwall

IN INDIA: Ruttonsha-Simpson Private, Ltd., Vikhroli, Bombay

DIGITAL INSTRUMENT

Warranty

SIMPSON ELECTRIC COMPANY warrants each digital instrument manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any digital instrument which shall within one (1) year after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any digital instrument which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

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OPERATOR'S MANUAL

SIMPSON 360-3 DIGITAL MULTIMETER

NOTE

This Operator's Manual contains information essential to the safe and proper operation of the instrument. Therefore, it should always be readily available to the user.

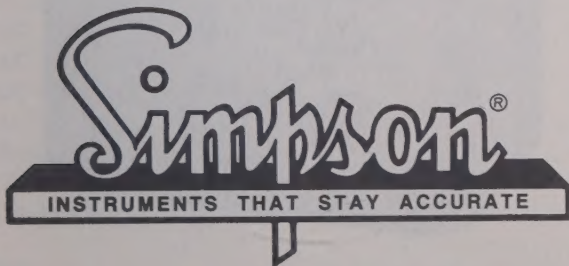




Figure 1-1. Simpson 360-3 Digital Multimeter

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WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

Multi-function instruments such as the 360-3 are intended as general purpose measuring instruments for use in relatively low power 120/240 V AC or dry battery operated circuits such as found in consumer appliances, home entertainment equipment or general laboratory applications. Some high power circuits, however, are within its measurement range and present an arcing/explosion hazard in the event of an unanticipated circuit behavior, a defective measuring instrument, or of an operator error if the operator has not recognized the hazard and observed appropriate personal protective measures. Such high power circuits that would be within the measuring range of this Instrument would be found in commercial or industrial equipment operating from AC and DC supply circuits above 240 V, storage battery banks or circuits containing large capacitors. Measurements in such circuits should only be performed by personnel trained to recognize the hazards and using appropriate safety measures. The Safety Precautions in Section IV are intended to alert the operator to the more commonly encountered hazards and protective measures to avoid them. The dangers in high power circuits are serious. Do not take safety precautions lightly.

NOTE: Any circuit containing voltages exceeding 30 V AC or 60 V DC should be considered to be a possible shock hazard and contact with the circuit should be avoided while the circuit is energized.

SAFETY CONSIDERATIONS

This manual contains CAUTION and WARNING headings alerting the user to possibly hazardous operating or maintenance conditions. This Instrument employs certain symbols and markings on its panel for the same purpose. These symbols and markings are defined below and must be understood by the user before operating the Instrument.

SAFETY SYMBOLS

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly performed or adhered to, could result in personal injury.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to a procedure, practice or the like, which if not correctly adhered to could result in damage to or destruction of part or all of the Instrument.

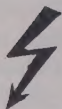


This marking adjacent to another marking or a terminal or operating device indicates that the Operator must refer to an explanation in the Operating Instructions to avoid damage to the equipment and/or to avoid personal injury.

ALL TERMINALS
ARE 300 V PEAK
(CHARGER) OR
1000 V PEAK
(BATTERY)



MAX. RATED CIRCUIT-TO-GROUND VOLTAGE: This marking and symbol limits the voltage, with respect to earth (power line) ground, that may be applied to any terminal of the Instrument to 300 V PEAK with charger connected or 1000 V PEAK without charger (battery operation).



HIGH VOLTAGE WARNING: A terminal at which a voltage, with respect to another terminal or to earth ground, exists or may be adjusted to 1000 volts or more AC or DC. The symbol is an additional warning that a very dangerous voltage may exist at the terminal, and the terminal and its connecting leads must not be handled while energized.



A terminal or circuit to which, or from which, a direct voltage or current may be applied or supplied.



A terminal or circuit to which, or from which, an alternating (sine wave) voltage or current may be applied or supplied.



SECTION I

INTRODUCTION

1.1 GENERAL

1.1.1 The Simpson 360-3 Digital Multimeter (hereafter referred to as the 360-3 or the Instrument) is a compact, 3½-digit instrument, suitable for both field and bench use in general electronic maintenance, production and laboratory. It features 0.1% DC voltage accuracy, solid-state integrated circuit electronics, AC line or self-contained battery operation, and LED display. Additional features are automatic polarity and excellent temperature characteristics.

1.1.2 The 360-3 measures DC and AC voltage, DC and AC current and resistance as specified in Table 1-3. The use of an LSI integrated circuit achieves high reliability, low power dissipation and a compact design.

1.1.3 The 360-3, Catalog No 12282, is supplied with an adapter/charger for 120 V AC, 50-400 Hz power line operation. The 360-3, Catalog No. 12284, is supplied with a 230 V adapter/charger for operation from a 220, 230 or 240 V AC power line. Both adapter/chargers are available separately as optional accessories.

For complete isolation from the power line or for operation where AC line power is not available, battery (only) operation can provide up to 12 hours of continuous operation.

1.1.4 The numerical display is a 7-segment light-emitting-diode (LED) for easy viewing and solid-state reliability. The numerals are 0.56 inch high and in a single plane for distant and wide-angle viewing. Ambient lighting effects are minimized by a filter which reduces reflections and background illumination.

1.1.5 Three "low power" resistance measuring ranges, which feature a maximum full-scale voltage of 500 millivolts, are provided. These ranges are useful in making resistance measurements in circuits containing semiconductor devices. The low full-scale voltage allows "in circuit" resistance measurement by reducing the shunting effect caused by semiconductor junction "turn on."

Introduction

1.2 ACCESSORIES AND SUPPLIES

All accessories and supplies required for operation of the 360-3 are furnished with the Instrument and are listed in Table 1-1. Additional available accessories are listed in Table 1-2.

Table 1-1. Items Furnished With Instrument

Quantity	Description	Ordering No.
1	Adapter/charger, 120 V or	Cat. No. 00743
1	Adapter/charger, 230 V	Cat. No. 00746
1	Test Lead Set, w/clips	Cat. No. 00043
1	Battery Pack, Ni-Cad, Special	Cat. No. 00046
1	Operator's Manual	Part No. 6-112991

Table 1-2. Available Accessories

Description	Catalog No.
Carrying Case	00820
RF Probe, 10 kHz to 250 MHz	00748
5 kV AC/DC High Voltage Adapter Probe	00053
AC Amp-Clamp Adapter, Mod. 153-2, 0-2/20/200 A	12494
Carrying Case for Amp-Clamp	00548
Line Splitter for Amp-Clamp	00544
Solid-State Temperature Probe Adapter, -58 to +302 °F	00758
Thermocouple Temperature Adapter, Dual Input, -30 to +1000 °F	00760
Thermocouple Lead, Type K C/A for use w/00760 Adapter	00171
40 kV DC High Voltage Probe	00749
40 kV DC High Voltage Probe Carrying Case	00804
Retractable Grip-Tip Test Prod Adapter	00118
Universal Test Lead System, 14 piece	00577
Deluxe Test Lead System, 23 piece	00818

Introduction

1.3 TECHNICAL DATA

Table 1-3 lists the technical specifications for the 360-3.

Table 1-3. Technical Data

1. DC Voltage

Range	Max. Indication	Input Resistance	Overload Capabilities
200 mV	± 199.9 mV	10 M Ω All Ranges	1000 V (DC + Peak AC) All Ranges
2 V	± 1.999 V		
20 V	± 19.99 V		
200 V	± 199.9 V		
2000 V	± 1000 (max.)		

Accuracy: (18° to 28 °C): $\pm(0.1\%$ of input + 1 count)

Sensitivity: 100 μ V on 200 mV range

Full Range Step Response (to rated accuracy): 1 second

Normal Mode Rejection: 50 dB min. at 50/60 Hz

Common Mode Rejection: 120 dB min. at 50/60 Hz with 1000 Ω unbalance

2. AC Voltage

Range	Max. Indication	Input Impedance	Overload Capabilities
200 mV	199.9 mV	10 m Ω and 100 pF All Ranges	1000 V (DC + Peak AC) or 750 V RMS All Ranges
2 V	1.999 V		
20 V	19.99 V		
200 V	199.9 V		
2000 V	750 V (max.)*		

*40 Hz to 400 Hz

Introduction

Accuracy (18°-28°C):

Range	40-400 Hz	400-1000 Hz	1 kHz-10 kHz
200 mV 2 V	$\pm (0.5\% + 2)^*$		$\pm (5\% + 2)^*$
20 V 200 V			
2000 V (750 max.)			

*% of input + number of counts

Sensitivity: 100 μ V on 200 mV range

Crest Factor (at full scale): 3

Waveform Response: Average sensing, RMS calibrated (sine wave)

Full Range Step Response (to rated accuracy): 3 seconds

3. DC Current

Range	Max. Indication	Voltage Drop (full range)	*Overload Protection
200 μ A	$\pm 199.9 \mu$ A	200 mV	2 A Fuse All Ranges Except 10 A
2 mA	± 1.999 mA	200 mV	
20 mA	± 19.99 mA	200 mV	
200 mA	± 199.9 mA	<300 mV	
2000 mA	± 1999 mA	<900 mV	
10 A	± 10.00 A (max.)	<200 mV	

*600 V Max. (DC + Peak AC) source voltage

Accuracy (18°-28°C): Range

Accuracy

200, 2000 mA

$\pm (0.75\% \text{ of input} + 2 \text{ counts})$

All others

$\pm (0.5\% \text{ of input} + 2 \text{ counts})$

Sensitivity: 100 nA on 200 μ A range

Full Range Step Response (to rated accuracy): 1 second

Introduction

4. AC Current

Range	Max. Indication	Voltage Drop (full range)	*Overload Protection
200 μ A	199.9 μ A	200 mV	2 A Fuse All Ranges Except 10 A
2 mA	1.999 mA	200 mV	
20 mA	19.99 mA	200 mV	
200 mA	199.9 mA	<300 mV	
2000 mA	1999 mA	<900 mV	
10 A	1000 (max.)	<200 mV	

*600 V Max. (DC + Peak AC) source voltage.

Accuracy (18°-28°C):

Range	40-1000 Hz	1 kHz-10 kHz
200 μ A	$\pm (1\% + 2)^*$	$\pm (6\% + 2)^*$
2 mA		
20 mA		
200 mA	$\pm (1.5\% + 2)^*$	
2000 mA		
10 A	$\pm (3\% + 2)^*$	Not specified

*% of input + number of counts

Sensitivity: 100 nA on 200 μ A range

Full Range Step Response (to rated accuracy): 3 seconds

5. Resistance

Range	Max. Indication	Short Ckt. Current	Open Ckt. Voltage	Overload Capabilities
200 ohms	199.9 Ω	1.94 mA	3.2 V	To 250 V RMS All Ranges
2 k Ω	1.999 k Ω	1.25 mA	3.2 V	
20 k Ω (L.P.)	19.99 Ω	60.6 μ A	.7 V	
200 k Ω (L.P.)	199.9 k Ω	6.9 μ A	.7 V	
2000 k Ω (L.P.)	1999 k Ω	699 nA	.7 V	
20 M Ω	19.99 M Ω	320 nA	3.2 V	

Introduction

Accuracy (18 °-28 °C): Range

20 M Ω

All others

Accuracy

$\pm(0.75\%$ of input + 2 counts)

$\pm(0.25\%$ of input + 1 count)

Sensitivity: 0.1 Ω on 200 Ω range

Full Range Response (to rated accuracy): 1 second except 7 seconds on 20 M Ω range

6. Rated Max. Circuit-To-Ground Voltage*: (Max. Common Mode Voltage)

This Instrument has floating measuring circuits. **Do not** connect any terminal to a circuit point at which the voltage, with respect to earth (power line) ground, exceeds:

a. Battery operation (charger disconnected):

1000 volts peak (DC + Peak AC)

750 volts RMS

b. With charger connected:

300 volts peak (DC plus Peak AC)

225 volts RMS

*The maximum voltage for which the Instrument is insulated against earth (power line) ground.

7. Transient Protection: Up to 6 kV to 100 μ sec max. on all voltage and resistance ranges

8. Display

Display:

3½-digit, 7 segment, .56" light emitting diode (LED) type display

Conversion Rate:

3 readings per second, nominal

DC Polarity Selection:

Automatic “-” indication, “+” implied

Introduction

9. Power Requirements:

Battery Charging: (AC Operation)	120 V AC $\pm 10\%$ or 230 V AC $\pm 15\%$, 50-400 Hz, 3 VA nominal
Battery Operation:	One battery pack consisting of four nickel-cadmium recharge- able cells, 4.8 V-1.2 A.H.
Battery Operation Time:	12 hours, nominal
Battery Recharge Time:	16 hours, nominal

10. Temperature Range:

Operating:	0° to +55 °C (32° to +131 °F)
Storage:	-40° to +60 °C (-40° to +140 °F)

11. Relative Humidity:

Operating:	0 to 90% (non-condensing) up to +35 °C; 70% max- imum up to +55 °C
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12. Temperature Coefficient:

(0 °C to +18 °C and +28 °C
to +55 °C) Less than 0.1
times the applicable ac-
curacy specification per °C

13. Reference Conditions:

Temperature: +25° ± 1 °C (77° ± 1.8 °F)
Relative Humidity: 30 to 60%
Atmospheric Pressure: 575 to 800 mm Hg

14. Weight: 3 lbs. (1.4 kg) with batteries, less charger

15. Dimensions: 7.2" (18.3 cm) high, 5.4" (13.7 cm) wide, 3.2" (8.1 cm) deep

SECTION II

PREPARATIONS FOR USE

2.1 GENERAL

2.1.1 This section contains information and instructions for preparing the new Instrument for use. Included are unpacking and inspection procedures, warranty, shipping and power source requirements.

2.2 UNPACKING AND INSPECTION

2.2.1 Examine the shipping carton for obvious signs of damage. Inspect the Instrument for possible damage incurred during shipment. If damage is noted, notify the carrier and supplier and do not attempt further use of the Instrument. If Instrument appears to be in good condition, read this Operator's Manual in its entirety. Become familiar with the Instrument as instructed in this manual, then proceed to check the electrical performance as soon as possible. Also, check that all items are included with the Instrument (Table 1-1).

2.2.2 Save the shipping carton and packing materials for future storing or shipping of the Instrument.

2.3 WARRANTY

The Simpson Electric Company warranty policy is printed on the inside front cover of this manual. Read it carefully prior to requesting a warranty repair. NOTE: for assistance of any kind, including help with the Instrument under warranty, contact your nearest Authorized Service Center for instructions. These centers are listed on the last pages of this manual. If you wish to contact the factory directly, give full details of the difficulty and include the Instrument model number, serial number and date of purchase. Service data or shipping instructions will be promptly sent to you. If an estimate of charges for non-warranty or other service work is required, a maximum charge estimate will be quoted. This charge will not be exceeded without prior approval.

Preparations For Use

2.4 SHIPPING

2.4.1 Pack the Instrument carefully and ship it prepaid to the proper destination. Insure the Instrument.

2.5 POWER SOURCE REQUIREMENTS

2.5.1 GENERAL

The 360-3 is intended to be operated from its internal battery at all times. The battery serves to limit, regulate and filter the charging voltage applied to the Instrument. The 360-3 can be operated from the charger (battery removed) in an emergency situation; however, the value displayed will be subject to fluctuations from AC line noise, and severe AC line transients could cause damage to the Instrument. Such operation without a battery should be minimized.

2.5.2 ADAPTER/CHARGER OPERATION

With battery installed and charger connected the battery charge will be maintained (plus a slight trickle charge) during operation. When the function switch is set to the OFF position, the battery will be charged at full rate.

- a. Make certain that the adapter/charger is rated for the supply circuit to be used (120 or 230 V).
- b. Observe the reduced rated circuit-to-ground voltage (Item 6, Table 1-3) when operating with adapter/charger connected.
- c. Connect the adapter/charger to the 360-3, turn the Instrument ON and notice the brightness of the display. If dim, the battery needs charging. Charge the battery at full rate (function switch OFF) for at least one hour before making any measurements. When time permits, charge the battery for 16 hours at full rate. A new battery should be charged 24 hours to assure a full charge.
- d. When the battery is fully charged, disconnect the adapter/charger and operate the Instrument from its internal battery until the display becomes noticeably dimmer, then recharge the

Preparations For Use

battery. Cycling of the charge is “healthy” for Ni-Cad cells and extends their useful life. Refer to BATTERY CHARGING instructions in paragraph 6.4. Avoid keeping the battery fully charged at all times.

2.5.3 BATTERY OPERATION

Battery operation (charger disconnected) affords complete isolation from the AC power line and the higher circuit-to-ground voltage rating in Table 1-3, Item 6.

- a. For maximum operating time in battery operation, the battery should first be fully charged. Refer to paragraph 6.4 for charging instructions.
- b. A battery in good condition and fully charged should provide about 12 hours of continuous operation.
- c. In battery operation, be sure to set the function switch to the OFF position when the Instrument is not in use to conserve the charge and to prevent a complete discharge if left in this position overnight. Such a complete discharge may cause polarity reversal in a “weaker” cell.

2.6 OPERATING POSITION

2.6.1 Positioning has no effect upon performance or accuracy of the 360-3. The Adjust-A-Vue handle may be positioned behind the case to support the Instrument at a convenient viewing angle.

SECTION III

CONTROLS, CONNECTORS AND INDICATORS

3.1 GENERAL

Become familiar with each item in Table 3-1 prior to operating the Instrument for the first time.

Table 3-1. Front and Rear Panel Description

1. Function Selector Switch

<u>Switch Position</u>	<u>Description</u>
OFF	Deenergizes internal battery circuits to conserve battery charge. With adapter/charger connected, this position charges the battery.
DC V, AC V, $k\Omega$, DC mA, AC mA	Selects the desired measuring function, as marked.

2. Range Selector Switch

<u>Switch Position</u>	<u>Description</u>
200 (mV, μ A, ohms)	Selects the lowest range of the function selected.
2 ( , )	Selects the 0-1.999 range of the function selected. In the resistance measuring function, this position is used for continuity (beeper) and diode tests.
20 (10 A)	Selects the 0-19.99 range of the function selected or the 0-10 A range when the 10 A jack is used.
200	Selects the 0-199.9 range of the function selected.
2000 (750 V AC, 1000 V DC)	Selects the 0-1999 range of the function selected. In the voltage function, the use of this range is limited to 1000 V DC or 750 V AC.

Controls, Connectors and Indicators

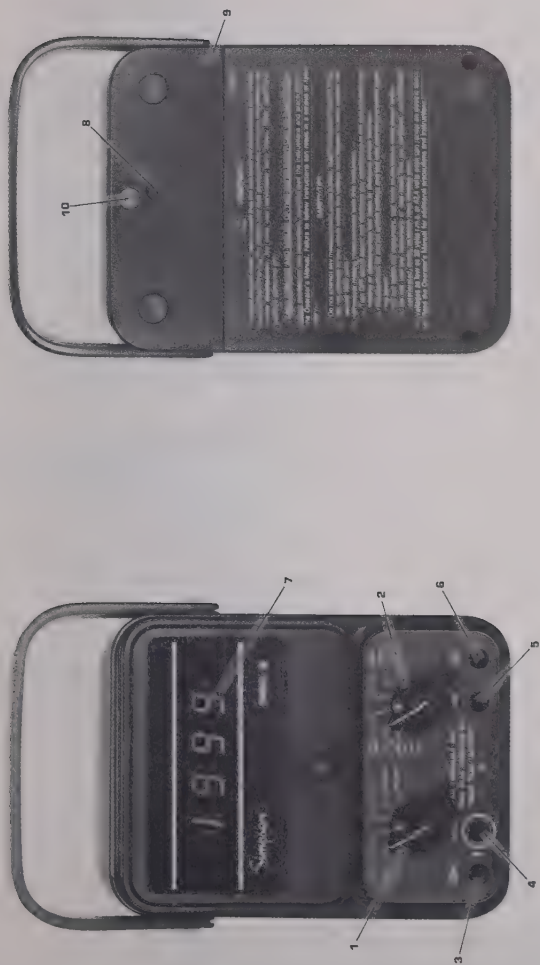


Figure 3-1. Controls, Connectors, Indicators

Controls, Connectors and Indicators

20 M Ω

Selects the 0-19.99 megohm resistance range.

3. COM Jack

This jack is used to connect the “low” side of the circuit being measured to the internal circuit common for all measuring functions and ranges. It is isolated from earth (power line) ground with or without the adapter/charger connected. It is the negative polarity for the resistance measuring functions.

4. V- Ω Jack

This jack is used to connect the “high” side of the circuit being measured to the voltage ranges and functions. It is also the positive polarity for the resistance measuring functions.

5. mA Jack

This jack in conjunction with the COM jack is used for all current measuring ranges except for the 10 A range.

6. 10 A Jack

This jack in conjunction with the COM jack provides the 0-10 A range.

7. Display:

The digital display uses LED's and includes:

- “ - ” polarity sign (“ + ” is implied by absence of the “ - ”)
- a “one” digit (first digit)

Controls, Connectors and Indicators

- c. three 0-9 digits (7 segment)
- d. a decimal point positioned by the range switch

Overrange (or out of range) conditions are indicated by the three 0-9 digits blanking out (the "one" and decimal point remain illuminated).

8. Adapter/Charger Input Jack:

This jack accepts the adapter/charger output plug to provide charging voltage for the Instrument.

9. Battery/Fuse Compartment Access Cover:

This easily removed (screwdriver or coin) cover provides convenient access to the battery and fuses.

10. Battery/Fuse Compartment Cover Retaining Screw (Captive)

SECTION IV

OPERATION

4.1 GENERAL

This section of the manual contains information required to operate the Instrument in a safe and proper manner.

WARNING

The Instrument is designed to prevent accidental shock when properly used. However, no engineering design can render safe an Instrument which is used carelessly. Therefore, this manual must be read carefully and completely prior to making any measurements. Failure to do so can result in a serious or fatal accident.

4.2 SAFETY PRECAUTIONS

NOTE: The following safety precautions are suggestions and reminders of commonly recognized safe practices and specific hazards to be avoided and are not implied to be sufficient to assure the safety of untrained personnel in all circumstances. Refer also to any precautions or safety instructions in the Instruction Manual for the equipment in which measurements are to be made.

4.2.1 The 360-3 is designed to be used only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury.

4.2.2 **Do not** work alone when making measurements in high voltage or high power circuits. Arrange for someone capable of rendering aid to be watchful and prepared to shut off the power quickly.

4.2.3 Keep in mind that dangerous voltages may appear unexpectedly or in unexpected locations in faulty equipment. An open bleeder circuit, for example, may result in a capacitor retaining a dangerous charge or an insulation failure may allow high voltage to appear where not expected. Be certain that all power is off and circuit capacitors are discharged before handling circuit components.

Operation

4.2.4 Except only when working in low voltage, dry cell powered transistor circuitry, it is always wisest to deenergize the circuit before connecting to, or disconnecting from, the circuit whenever possible.

4.2.5 Locate all high voltage points in the circuit and take precautions to avoid accidental or inadvertent contact with them while the circuit is energized.

4.2.6 Beware of low voltages that may be floating at a high voltage with respect to earth (power line) ground. Make certain that the floating voltage does not exceed the Instrument's rated max. circuit-to-ground voltage (refer to Table 1-3, item 6).

4.2.7 For your own safety and particularly if the 360-3 is shared with others, carefully inspect the Instrument, its test leads and any accessories for damaged, missing or deteriorated insulation before using it. Replace any such faulty part(s) before using the Instrument.

4.2.8 Most measuring instruments are not waterproof (unless so identified) and must be sheltered from rain or snow. If subjected to condensation, the Instrument must be thoroughly dried before measuring high voltages.

4.2.9 Wet or damp earth or concrete floors and leather-soled shoes increase the risks of electric shock. If necessary to work in such conditions, stand on insulating rubber mats or dry wood.

4.2.10 Do not sit upon or make any bodily contact with earth grounded (or possibly suspected earth-grounded) objects while making measurements in energized circuits.

4.2.11 For maximum safety, avoid contact with the Instrument, its test leads or the circuit being measured while the circuit is energized. The test leads may have invisible damage or the circuit voltages may be much higher than anticipated.

4.2.12 Do not attempt to measure composite (AC + DC) voltages such as found in RF amplifiers. The 360-3 cannot measure composite voltages meaningfully and the peak value may exceed the ratings of the Instrument.

Operation

4.2.13 Take extreme precautions to avoid accidental or inadvertent short-circuiting of AC or DC commercially supplied power circuits when making measurements, particularly those above 250 V which can produce dangerous explosive arcing. If at all possible, connect to, or disconnect, from such circuits when de-energized and stand clear when energized. If such circuits must be worked "live," wear non-flammable protective clothing, insulating gloves, safety glasses, hard-hat, etc.

4.2.14 Never exceed the Instrument's rated maximum circuit-to-ground voltage as specified in Table 1-3, item 6 of this manual.

4.3 PRELIMINARY NOTES AND CHECKS

4.3.1 Before operating a new instrument, refer to Preparations For Use, Section II.

4.3.2 If the Instrument has been idle for some period of time and the display is dim or does not light, the battery may need charging. Refer to paragraph 6.4 for charging instructions.

4.3.3 For a quick-check of the Instrument's operation, check its resistance function as follows:

- a. Set the function switch to the $k\Omega$ position and the range switch to 200 (0-199.9 Ω).
- b. Connect a test lead between the COM and the V- Ω jacks. The display should indicate 00.0 plus the resistance of the test lead (should be $<0.1 \Omega$).
- c. If the indication exceeds 00.1-00.2, the test lead may be picking up nearby electric-magnetic radiation, or the Instrument may be in need of repair.
- d. Disconnect the test lead from the jacks. The display should indicate overrange (only "1" and decimel point illuminated).

4.4 DC VOLTAGE MEASUREMENT

4.4.1 Review the safety precautions in paragraph 4.2.

Operation

4.4.2 Connect the black test lead to the COM jack and the red test lead to the V- Ω jack.

4.4.3 Set the function switch to DCV.

4.4.4 Set the range switch to an appropriate range in accordance with Table 4-1.

NOTE: If the voltage to be measured is unknown or uncertain, start first with the highest range (2000) and then switch downward as appropriate.

WARNING

Do not attempt to measure a voltage that may exceed 1000 V. If in doubt, first use a 5 kV high voltage probe to make certain that the voltage is 1000 V or less.

Table 4-1. DC Voltage Ranges

Range (Auto-Polarity)	Range Switch Position	Input Resistance	Max. Overload
0 to ± 199.9 mV	200 mV	10 M Ω All Ranges	± 1000 V (DC + peak AC) All Ranges
0 to ± 1.999 V	2		
0 to ± 19.99 V	20		
0 to ± 199.9 V	200		
0 to ± 1000 V (max.)	2000		

4.4.5 Turn off power to the circuit to be measured; all capacitors, if any, are to be discharged.

4.4.6 Connect the black test lead to the negative side of the circuit (if known) and the red lead to the positive side (if known).

4.4.7 Apply power to the circuit. The display will indicate the voltage value and polarity. A “-” indication means that the negative polarity is connected to the V- Ω jack. Absence of a “-” indication implies that the negative polarity is connected to the COM jack.

4.4.8 Remove all power from the circuit being measured and wait until the display indicates at or near 00.0 (<60 V) before disconnecting the test leads.

Operation

4.5 AC VOLTAGE MEASUREMENT

4.5.1 Review the safety precautions in paragraph 4.2.

4.5.2 Connect the black test lead to the COM jack and the red test lead to the V- Ω jack.

4.5.3 Set the function switch to ACV position.

4.5.4 Set the range switch to an appropriate range in accordance with Table 4-2.

NOTE: If the voltage to be measured is unknown or uncertain, start first with the highest range (2000) and then switch downward as appropriate.

WARNING

Do not attempt to measure a voltage that may exceed 750 V. If in doubt, first use a 5 kV high voltage probe to make certain the voltage is 750 V or less.

Table 4-2. AC Voltage Ranges

Range	Range Switch Position	Frequency Range	Input Impedance	Max. Overload
0 to 199.9 mV	200 mV	20 Hz-10 kHz	10 M Ω and 100 pF All Ranges	750 V RMS or 1000 V (DC + Peak AC) All Ranges
0 to 1.999 V	2			
0 to 19.99 V	20	20 Hz-1 kHz		
0 to 199.9 V	200			
0 to 750 V (max.)	2000	20 Hz-400 Hz		

4.5.5 Turn off power to the circuit to be measured.

4.5.6 Connect the black test lead to the “low” (nearest to earth ground) side of the circuit and the red lead to the “high” side of the circuit.

4.5.7 Apply power to the circuit. The display will indicate the voltage value.

4.5.8 Remove all power from the circuit and make certain that the display indicates at or very near zero (<30 V) before disconnecting the test leads.

Operation

4.6 DC CURRENT MEASUREMENT

4.6.1 Review the safety precautions in paragraph 4.2.

4.6.2 Connect the test leads to the appropriate jacks in accordance with Table 4-3.

4.6.3 Set the function switch to DCmA.

4.6.4 Set the range switch to an appropriate range in accordance with Table 4-3.

NOTE: If the current to be measured is unknown or uncertain, start first with the highest range (0-10A) and then switch downward and change jacks as appropriate.

Table 4-3. DC Current Ranges

Range (Auto-Polarity)	Range Switch Position	Jacks Used		Voltage Drop	*Max. Overload
		-	+		
0 to $\pm 199.9 \mu\text{A}$	200 μA	COM	mA	200 mV	$\pm 2\text{A}$
0 to $\pm 1.999 \text{ mA}$	2	COM	mA	200 mV	(Fused)
0 to $\pm 19.99 \text{ mA}$	20	COM	mA	200 mV	All Ranges
0 to $\pm 199.9 \text{ mA}$	200	COM	mA	<300 mV	Except
0 to $\pm 1999 \text{ mA}$	2000	COM	mA	<900 mV	$\pm 10 \text{ A}$
0 to $\pm 10 \text{ A}$	20 (10 A)	COM	10 A	<200 mV	(Not Fused)

*600 V Max. (DC + Peak AC) source voltage.

4.6.5 Turn off all power to the circuit and discharge all capacitors, if any.

4.6.6 Open the circuit in which the current is to be measured and connect the test leads so that the instrument is in **series** with the circuit. Make certain that a current measuring range is not inadvertently connected **across** a source of voltage.

NOTE: Whenever possible, connect the 360-3 into the ground (or nearest to ground) side of the circuit to minimize the circuit-to-ground voltage to the Instrument.

4.6.7 Apply power to the circuit. The display will indicate the value and polarity of the measured current. A “-” indication means that the negative polarity is connected to the V- Ω jack. Absence of a “-” indication implies that the negative polarity is connected to the COM jack.

Operation

4.6.8 Remove all power from the circuit being measured and wait until the display indicates 00.0 before disconnecting the test leads.

4.6.9 After current measurements are completed, immediately set the function switch to OFF and the range switch to 2000, and move the test lead from the mA jack to the V- Ω jack. These settings avoid inadvertent connection of a current range to a voltage source if the Instrument is next used to measure voltage.

4.7 AC CURRENT MEASUREMENT

4.7.1 Review the safety precautions in paragraph 4.2.

4.7.2 Connect the test leads to the appropriate jacks in accordance with Table 4-4.

4.7.3 Set the function switch to ACmA.

4.7.4 Set the range switch to an appropriate range in accordance with Table 4-4.

NOTE: If the current to be measured is unknown or uncertain, start first with the highest range (0-10 A) and then switch downward and change jacks as appropriate.

Table 4-4. AC Current Ranges

Range	Range Switch Position	Jacks Used	Frequency Range	*Max. Overload
0 to 199.9 μ A	200 μ A	COM mA		2 A
0 to 1.999 mA	2	COM mA	40 Hz	(Fused)
0 to 19.99 mA	20	COM mA	to	All Ranges
0 to 199.9 mA	200	COM mA	10 kHz	Except
0 to 1999 mA	2000	COM mA	All Ranges	10 A
0 to 10 A	20 (10 A)	COM 10 A		(Not Fused)

*600 V Max. (DC + Peak AC) source voltage.

4.7.5 Turn off all power to the circuit to be measured.

4.7.6 Open the circuit in which the current is to be measured and connect the test leads so that the Instrument is **in series** with the circuit. **Make certain that a current measuring range is not inadvertently connected across a source of voltage.**

Operation

NOTE: Whenever possible, connect the 360-3 into the ground or neutral (or nearest to ground) side of the circuit for minimum circuit-to-ground voltage to the Instrument.

4.7.7 Apply power to the circuit. The display will indicate the value of the measured current.

4.7.8 Remove all power from the circuit being measured and make certain that the display returns to zero before disconnecting the test leads.

4.7.9 After current measurements are completed, immediately set the function switch to OFF and the range switch to 2000 and move the test lead from the mA jack to the V- Ω jack. These settings avoid inadvertent connection of a current range to a voltage source if the Instrument is next used to measure voltage.

4.7.10 Reconnect the circuit that was measured.

4.8 RESISTANCE MEASUREMENT

CAUTION

If the resistance to be measured is connected into a circuit, be certain that all power has been removed from the circuit and that all capacitors, if any, have been discharged. A small residual circuit voltage will cause measurement inaccuracy and higher voltages may damage the Instrument.

NOTE: For in-circuit measurements, check for alternate resistance paths in parallel with the resistance being measured. Such paths can cause a measured value lower than the actual value.

4.8.1 Connect the test leads to the COM and the V Ω jacks.

4.8.2 Set the function switch to the k Ω position.

4.8.3 Set the range switch to an appropriate range in accordance with Table 4-5.

Operation

Table 4-5. Resistance Ranges

Range	Range Switch Position	Open Ckt. Voltage	Short Ckt. Current	Remarks
0 to 199.9 Ω	200 ohms	<3.2 V	1.94 mA	
0 to 1.999 k Ω	2*	<3.2 V	1.25 mA	
0 to 19.99 k Ω	20	< .7 V	60.0 μ A	“Low Power Ohms” Ranges
0 to 199.9 k Ω	200	< .7 V	6.9 μ A	
0 to 1999 k Ω	2000	< .7 V	699 nA	
0 to 19.99 M Ω	20M Ω	<3.2 V	320 nA	

*Continuity check (beeper) and diode check position. Refer to paragraphs 4.9 and 4.10.

NOTE: If the resistance being measured is polarity or voltage sensitive, or current limited (semi-conductors, for example), review the open-circuit voltage and short-circuit specifications in Table 4-5 before making a measurement. Refer also to the Diode Test instructions in paragraph 4.10.

4.8.4 Connect the test leads across the resistance to be measured.

NOTE: Avoid finger contact with the connectors and probe contact with adjacent insulation. In the higher resistance ranges such contacts may result in parallel paths, causing the indicated value to be lower than the actual value.

4.8.5 The display will indicate the resistance value.

NOTE: After resistance measurements are completed, immediately set the function switch to OFF and the range switch to 2000. These settings avoid inadvertent connection of a resistance range to a voltage source if the Instrument is next used to measure voltage.

4.9 CONTINUITY CHECK (<500 Ω “beep”)

4.9.1 Connect the test leads and set the selector switches for resistance measurement in the 2(, ) range (0.199 k Ω). Refer to paragraph 4.8.

4.9.2 Connect the test leads to the circuit. If the circuit resistance is less than approximately 500 Ω , a “beep” will be heard.

Operation

4.9.3 After continuity checks are completed, immediately set the selector switch to OFF and the range switch to 2000. These settings avoid inadvertent connection of the resistance range to a voltage source if the Instrument is next used to measure voltage.

4.10 DIODE CHECKS

4.10.1 This is a basic check to determine if the diode is either shorted or open but **does not** assure that the diode will perform properly in its application. The test criteria is that the forward resistance should be (relatively) low and the backward resistance should be (relatively) high.

NOTE: The diode to be checked must be out-of-circuit or one lead disconnected.

4.10.2 Connect the black test lead to the COM jack (– polarity) and the red test lead to the V- Ω jack (+ polarity).

4.10.3 Set the range switch to the k Ω position and the range switch to 2(, ) for the 0-1.999 k Ω range.

4.10.4 To check forward resistance, connect the red lead (+) to the diode anode and the black lead (–) to the diode cathode. The display should indicate a low value of resistance. A typical silicon diode will indicate between .600 and 1.000 k Ω ; a germanium diode will indicate between .200 to .300 k Ω .

4.10.5 To check backward resistance, transpose the connections to the diode. The display should indicate overrange (only the “1” digit and the decimal point illuminated).

4.10.6 When all checks have been completed, immediately set the function switch to OFF and the range switch to 2000. These settings avoid inadvertent connection of the resistance range to a voltage source if the Instrument is next used to measure voltage.

SECTION V

THEORY OF OPERATION

5.1 OVERALL SYSTEM

The basic system diagram for the Simpson 360-3 is shown in Figure 5-1.

5.1.1 Signal Conditioning Section

The parameter being measured is connected to the appropriate input terminals. The corresponding Signal Conditioning circuits convert this parameter into a proportional DC voltage. The conversion is accomplished by the Attenuator, Current Shunts, Resistance Converter, AC-to-DC Converter, and associated switching.

5.1.2 Analog-To-Digital Converter Section

The Analog-To-Digital (A/D) Converter section changes the DC output voltage from the Signal Conditioning section to digital information.

5.1.3 Display Section

The Analog-To-Digital (A/D) Converter decodes the internal BCD into 7-segment information by the on-board decoder driver. The decoded digital information is visually presented on the numerical display.

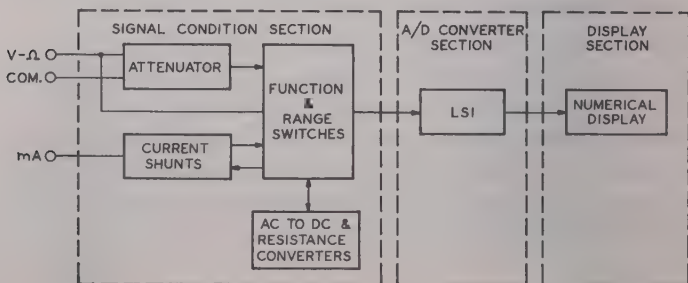


Figure 5-1. Basic System Diagram

Theory of Operation

5.2 INPUT CIRCUITS

5.2.1 DC Voltage Measurements

The basic DC voltage measurement circuit is shown in Figure 5-2(a). The DC voltage being measured is connected to the + and COM jacks, attenuated according to the range selected and converted into digital information by the A/D Converter.

5.2.2 The A/D Converter circuit provides two basic full range sensitivities: 200 mV and 2 V. This feature simplifies the attenuator design. No attenuation is required on the 200 mV and 2 V ranges. The same attenuator ratio is used on the 20 V and 200 V ranges. A separate attenuator tap is provided for the 1000 volt range.

5.2.3 AC Voltage Measurements

The basic AC voltage measurement circuit is shown in Figure 5-2(b).

5.2.4 The AC voltage being measured is connected to the V- Ω and COM jacks, attenuated according to the range selected, and applied to the amplifier. The output of the amplifier is converted into DC by an AC-To-DC Converter, and the resulting DC voltage is measured by the converter.

5.2.5 The Attenuator is not used on the 200 mV and 2 V ranges. On the higher ranges, the attenuator is frequency-compensated to provide good accuracy over a wide frequency range.

5.2.6 The Amplifier achieves a high input impedance that is required to maintain the high accuracy of the Instrument.

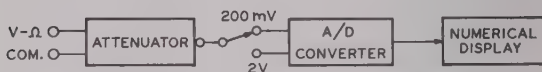
5.2.7 The AC-To-DC Converter uses a half-wave operational amplifier/rectifier circuit which provides two basic full range sensitivities: 200 mV and 2 V. It is average-responding, but its calibration (gain) is based on the RMS value of a sine wave.

5.2.8 The output of the Operational Amplifier has two rectifying diodes and two feedback resistors, R1 and R2. These components drive a summing resistor, R3. The junction of the summing

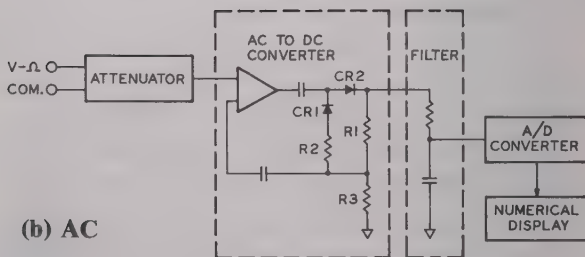
Theory of Operation

resistor and feedback resistors is connected to the amplifier input to provide negative feedback. With a sine wave input signal, the positive half cycles of the output waveform go through one diode and the negative half cycles through the other diode. The positive half cycle is filtered and the resulting DC voltage is measured by the A/D Converter.

5.2.9 The indications of the numerical display are calibrated to the RMS sine wave value being measured.



(a) DC



(b) AC

Figure 5-2. Basic Voltage Measurement Circuits

Theory of Operation

5.2.10 DC Current Measurements

The basic DC current measurement circuit is shown in Figure 5-3(a).

5.2.11 The current being measured is connected in series with the COM and mA or 10 A jack and an internal precision shunt resistance. The value of the shunt resistance depends on the current range used and is selected so that the voltage developed across it is proportional and numerically equal to the current through it. The A/D Converter measures this voltage, and the value indicated on the numerical display is equal to the current being measured.

5.2.12 The full range sensitivity of the digital voltmeter circuit measurements is 200 mV. Therefore, the internal resistance for each current range equals 200 mV divided by the full range current. For example, if the full range current is 200 μ A, then the internal resistance would be 1000 Ω .

5.2.13 AC Current Measurements

The basic AC current measurement circuit is essentially the same as the DC current measurement circuit (refer to paragraph 5.2.10), except that the voltage developed across the internal shunt resistance is measured by the AC voltage measurement circuit.

5.2.14 Resistance Measurements

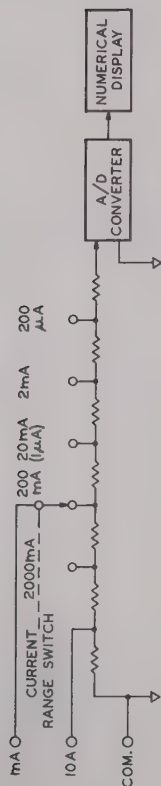
The basic resistance circuit is shown in Figure 5-3(b).

5.2.15 The resistance being measured, R_x , is connected to the V- Ω and COM jack.

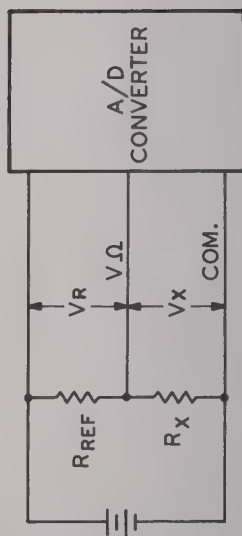
5.2.16 A voltage ratio is made by comparing the unknown resistance (R_x) with an internal standard resistance (R_{Ref}). The voltage ratio is applied to the A/D Converter to yield a numerical value which is proportional to the unknown resistance as shown in the figure. The ranges of the resistance measurement circuit are determined by the range switch.

5.2.17 The low power range feature is accomplished by regulating the ohms measuring voltage to a lower potential.

Theory of Operation



(a) Current



(b) Resistance

Figure 5-3. Basic Current and Resistance Measurement Circuits

SECTION VI

OPERATOR MAINTENANCE

6.1 GENERAL

WARNING

Improper repairs can be dangerous to the operator of the Instrument. Servicing, other than the replacement of fuses or the battery, should be performed only by qualified personnel or one of the Simpson Authorized Service Centers listed in the back of this manual.

The 360-3 is carefully designed and constructed with high quality components. By providing reasonable care and following instructions in this manual, the user can expect a long, useful service life from the Instrument.

6.2 BATTERY AND FUSE ACCESS

WARNING

Disconnect the adapter/charger and the test leads from the Instrument before removing the battery/fuse compartment cover. Do not use the Instrument to make any measurements without first replacing the cover.

6.2.1 Disconnect the adapter/charger, if connected, and set the function switch to OFF.

6.2.2 Loosen the captive screw with a screwdriver or coin. Remove the cover. To replace the cover, engage the lip of the bottom edge with the case and, while holding the cover in place, tighten the screw snugly.

6.3 BATTERY REPLACEMENT

NOTE: For maximum performance and battery life, use only the proper replacement Nickel-Cadmium rechargeable battery as supplied with the Instrument. Refer to Table 1-1.

6.3.1 Remove the battery compartment cover in accordance with paragraph 6.2. The battery is now accessible.

Operator Maintenance

CAUTION

The battery connector is polarized by a tab on the circuit board portion of the connector. Exercise care when disconnecting or connecting the battery to avoid breaking off the tab. Without the tab, the connector can be mated in reverse polarity and the battery will be short-circuited, causing the battery fuse (F201) to blow and possibly damage the Instrument.

6.3.2 Noting how the battery is positioned inside the compartment, disconnect its connector from the circuit board and lift the battery out. Refer to Figure 6-1.

6.3.3 Insert the new battery in the same position as the old one.

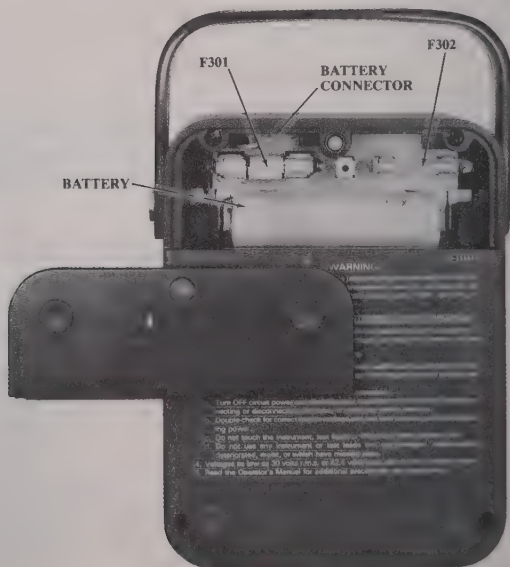


Figure 6-1. Simpson 360-3 Fuse Location

Operator Maintenance

CAUTION

Install the battery with its metal tabs pointing away from the metal bracket and make certain that the tabs will not come into contact with the bracket after the battery is installed. Such contact may short-circuit the battery and blow the battery fuse, F201.

6.3.4 Connect the battery connector to the circuit board connector and replace the compartment cover.

6.3.5 Connect the adapter/charger and charge the battery for at least 1 hour. Refer to charging instructions in paragraph 6.4.

6.4 BATTERY CHARGING

6.4.1 The battery should only be charged when:

- a. The battery is new, or
- b. The display has become noticeably dimmer, or
- c. Prior to extended usage, where AC line power will not be available for charging.

Cycling of the charge is "healthy" (recharge after discharge) for Ni-Cad batteries and extends their useable life. Do not try to keep them fully charged at all times.

6.4.2 Charging time will depend on several factors:

- a. New battery to be charged at least 1 hour before use.
- b. When time permits, a new battery should be charged for about 24 hours.
- c. When the display has become noticeably dimmer and time does not permit a full recharge, the battery should be charged for at least 1 hour.
- d. For a full recharge, the battery should be charged for about 16 hours (overnight).

6.4.3 To charge the battery, connect the adapter/charger and set the function switch to OFF. After charging, disconnect the adapter/charger until it is again needed.

Operator Maintenance

6.5 BATTERY CARE

6.5.1 Avoid allowing the battery to become completely discharged. Recharge it whenever the display becomes noticeably dimmer. If the charge falls below this point, instrument performance will deteriorate.

6.5.2 When the charger is not connected, set the function switch to OFF between usages of the Instrument to conserve the charge.

6.5.3 Avoid storage of the Instrument with the Ni-Cad battery installed where the temperature might exceed 60 °C (140 °F).

6.6 FUSE REPLACEMENT

6.6.1 The fusing system in the Instrument relies upon using the proper type, rating and blo-characteristic fuses for optimum protection to the Instrument. Do not substitute an incorrect fuse type.

6.6.2 The Instrument contains three fuses. (refer to Figure 6-2):

F201 Battery Fuse, Type 3AG, 2 A, 250 V, Fast-blo.

F301 Current Fuse, Type BBS, 3 A, 600 V, Fast-blo.

F302 Current Fuse, Type 3AG, 2 A, 250 V, Fast-blo.

6.6.3 F201 Battery Fuse

The sole purpose of this fuse is to protect the battery from bursting in the event of short-circuiting of the +5 V supply on the P.C. board. It is not subject to overloads in the measuring ranges of the Instrument and the need to replace it will be extremely rare, if ever. This fuse is not accessible in the fuse compartment and requires removal of the Instrument's case for access. (Refer to paragraph 6.6.7.)

6.6.4 F301 and F302 Current Fuses

These fuses protect the current measuring ranges (except for the 10 A range). If the Instrument operates in all functions except DCmA and ACmA, one or both of these fuses probably needs replacement.

6.6.5 To replace F301 or F302, remove the battery/fuse compartment cover in accordance with paragraph 6.2. F301 is the larger fuse. (Refer to Figure 6-1.)

Operator Maintenance

6.6.6 Replacement the compartment cover.

6.6.7 To replace the battery fuse F201:

NOTE: The battery fuse is only likely to be blown from a serious battery circuit fault inside the Instrument or as a result of an accidental short-circuit of the battery circuit (+ 5 V) on the PC board during Instrument maintenance or service. In most such cases the blown fuse will also be accompanied by the circuit fault or damage that caused the fuse to blow, and the Instrument will require repair as well as replacement of the fuse. Refer to Section VII for Servicing Instructions.

- First refer to the Troubleshooting Chart, Table 6-1, Symptoms 1 and 3, and eliminate the other probable causes of no indication. If a blown battery fuse is indicated, proceed as follows.
- Remove the battery/fuse compartment cover in accordance with paragraph 6.2.
- Disconnect and remove the battery in accordance with paragraph 6.3.
- Remove the four deeply recessed screws from the case back (one at each corner), and carefully lift off the case back. The battery fuse is now accessible (refer to Figure 6-2).

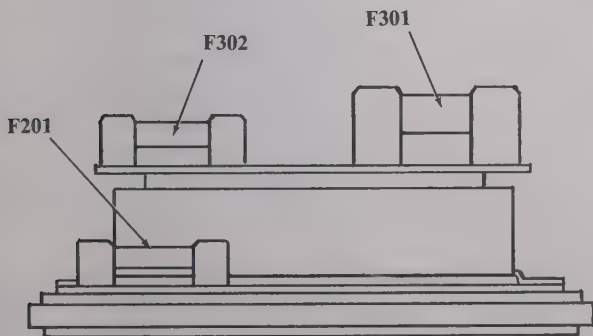


**Figure 6-2. Battery Fuse Location
(Case Back Removed)**

Operator Maintenance

- e. Replace the fuse with the correct type and rating, being careful not to disturb any components or lead dress inside the Instrument.
- f. Replace the battery in accordance with paragraph 6.3 and re-assemble the case and compartment cover.
- g. If the fuse was found to have been blown and replacing it did not restore operation, circuit damage is indicated. Refer to Section VII for Servicing Instructions.

6.7 INSTRUMENT CARE

6.7.1 Dirty or contaminated insulation can be dangerous. Do not allow the jack and switch areas of the control panel nor the test leads, particularly the hand-held test prods, to accumulate a coating of dirt which may retain moisture or be conductive. When such accumulations are observed, use a clean rag moistened with a mild detergent and water solution to clean the surfaces. Then with a clean rag moistened with clean water, wipe off the detergent and dry thoroughly before use. Do not permit moisture to enter the case, and avoid the use of chemical solvents. Some solvents may damage the plastic display window (or even the case) or the test prods and connectors.

6.7.2 All electrical measuring instruments should be checked for **performance** and **accuracy** in all functions and ranges periodically to detect gradual performance deterioration that might not be noticed in regular usage of the Instrument. The frequency of such checks is determined by the measurement accuracy required, the availability of suitable calibration standards, and the Instrument's past history. If monthly checks indicate the Instrument to be stable, the check periods can be extended accordingly. If the Instrument's accuracy specifications are important, it should be checked at least once or twice yearly.

6.7.3 When the Instrument is not in use, **store** it in a location free from temperature extremes, high humidity, dust and corrosive fumes, and mechanical shock and vibration. When **transporting** the Instrument, protect it as much as possible from the above conditions. A protective carrying case (Catalog 00820) can be a good investment.

Operator Maintenance

NOTE: When an Instrument has been in a cold location for any period of time and is brought into a warm location, it may experience condensation. Do not make measurements until the Instrument has been allowed to dry thoroughly.

6.8 TROUBLESHOOTING

6.8.1 If the Instrument does not yield satisfactory results, perform the following procedures:

- a. Review the Preliminary Notes and Checks in paragraph 4.3 and Preparations for Use in Section II.
- b. Make certain that the measurement is within the Instrument's specification limits in Table 1-3.
- c. Make certain that the operating instructions in Section IV are being observed.
- d. Find the appropriate SYMPTOM in Table 6-1 and check the PROBABLE CAUSES AND CURES.

6.8.2 If the above checks do not resolve the problem, the Instrument most likely requires repair services. Refer to Section VII for Servicing Instructions.

Table 6-1. Troubleshooting Chart

SYMPTOM	PROBABLE CAUSE	CURE
1. No indication on numerical display when Instrument is battery operated. With AC adapter/charger operation OK.	a) Battery discharged, or battery connector not connected or making poor connection.	Remove battery cover and check battery connection and voltage. If OK, contact nearest Simpson Authorized Service Center or the factory.
2. Low intensity on numerical display in battery operation.	a) Battery not fully charged. b) Defective cell in battery.	a) Connect AC adapter/charger and charge overnight. Refer to paragraph 6.4. b) Replace battery.

Operator Maintenance

Table 6-1. Troubleshooting Chart (continued)

SYMPTOM	PROBABLE CAUSE	CURE
3. No indication on numerical display when Instrument is battery or AC adapter/charger operated.	a) F201 blown.	a) Check F201 and replace if necessary. Refer to paragraph 6.6 Fuse Replacement.
	b) Defective adapter/charger and battery discharged.	b) Check charger output and battery voltage. If battery voltage is low and charger has no output, replace charger and charge battery overnight. If OK, contact nearest Simpson Authorized Service Center or factory.
	c) Low or no voltage at power source receptacle and battery discharged.	c) Restore correct voltage at power receptacle and charge battery overnight.
4. Battery does not respond to charge. Instrument operation OK when connected to AC power.	Battery defective, battery connector not making proper contact, or battery missing.	Remove cover and check that battery is installed correctly and connector is making good contact. Refer to paragraph 6.2. If it is, check the voltage of the battery. Replace the battery if it checks significantly lower than nominal (4.00 volts) after charging. Refer to paragraph 6.3.

Operator Maintenance

Table 6-1. Troubleshooting Chart

SYMPTOM	PROBABLE CAUSE	CURE
5. Operation normal on all functions and ranges except AC and DC current.	Current fuse F301 or F302 or both open.	Check and replace fuses as necessary. Refer to paragraph 6.6.
6. Indications fluctuate and/or drift, even though indication is OK at 000 with the input terminals shorted, and at 1000 counts when using a stable and low impedance input.	Fluctuations and/or drift are being generated by the device being measured or the measurement test setup. NOTE: If the drift and/or fluctuation is coming from the device being measured, no cure is required, the measurement is valid, and the device must be corrected.	Use proper shielding, ground-techniques, and connections to minimize "pick-up" of unwanted signals due to ground loops, poor connections, and capacitive and/or inductive coupling. Operate Instrument on battery for complete isolation from the power line.
7. Indication is OK on battery. However, on AC operation, the reading fluctuates and/or drifts at 000, with the input shorted, and/or at 1000 counts using a stable and low impedance input.	AC power source is low or fluctuating (including transients).	Correct the power source or use Instrument on battery.
8. Same as 7 above, except indication OK on AC but not on battery operation.	a) Battery voltage low.	a) Check the battery condition. Refer to paragraph 4.3.2. If not OK, charge battery; refer to paragraph 6.4.

Operator Maintenance

Table 6-1. Troubleshooting Chart (continued)

SYMPTOM	PROBABLE CAUSE	CURE
	b) One or more cells in battery are defective.	b) Remove back cover and check that battery connector is making good contact. Refer to paragraph 6.2. If OK, and battery does not charge to proper voltage, replace battery.
9. Slow response. Operation OK when using a low impedance input.	Parameter being measured has a high source impedance.	None required.
10. Accuracy not within specifications when checked with a stable, higher accuracy (at least 5 times better) low impedance (voltage measurements) source.	Instrument is out of calibration, or instrument will not zero when leads are shorted together with the range and function selector switches set for 200 mV DC.	Contact nearest Simpson Authorized Service Center or factory.
11. Accuracy of Instrument is within specifications but measurements appear in error.	a) Instrument affects circuit being measured. b) Common and/or normal mode specification is being exceeded.	a) Study circuit being measured vs. Instrument specifications. Correct indications accordingly. b) Refer to cure in item 6 above.

WARNING

The following servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that contained in the Operator's Maintenance section of this manual unless you are qualified to do so.

SECTION VII

SERVICE INFORMATION

7.1 GENERAL

Refer to paragraph 2.3 for instructions for obtaining servicing assistance.

7.2 REPLACEMENT PARTS

7.2.1 Table 7-1 lists replacement parts for the 360-3 and the ordering part number. Replacement parts and accessory items may be ordered from any of the Authorized Service Centers listed on the last pages of this manual or the factory. Refer also to Warranty paragraph 2.3. Be sure to describe the part(s) fully as shown in the table and provide the model number of the Instrument (360-3).

7.3 CIRCUIT DIAGRAM

7.3.1 Figure 7-1 is the Schematic Diagram for the 360-3.

7.4 REMOVING CASE BACK

For access to the interior of the Instrument, refer to paragraph 6.6.8, battery fuse replacement.

Table 7-1. Replacement Parts List, 360-3

<u>Reference Symbol</u>	<u>Description</u>	<u>Part No.</u>
	Replacement Test Lead Set w/Clips	Cat. No. 00043
	Screw-on Alligator Clip Set	10-864240
	Battery/Fuse Compartment Cover	10-560330
	Battery Pack (Special)	Cat. No. 00046
	Function or Range Switch Knob	10-864352
	Grounding Coil Spring	6-163016
	Operator's Manual	6-112991
IC101	I.C. AR4750, DC-DC Converter	6-111607
IC102	I.C. CD4001, Quad 2-input NOR Gate	6-113007
IC103,104	I.C. DC4053, Triple 2-channel Analog Switch	6-112215
IC105,106	I.C. TL061CP, Operational Amp	6-113008

Service Information

<u>Reference Symbol</u>	<u>Description</u>	<u>Part No.</u>
IC107	I.C. CD4093, Quad 2-input NAND Gate	6-112216
IC201	I.C. 7137, 3½ digit A/D Converter	6-113006
Q101,103,105,202	Transistor, 2N4123, Silicon, NPN	5-115931
Q102,203	Transistor, MPS3702, Silicon, PNP	5-113864
Q106	Transistor, J108, Field Effect	6-113009
Q201	Transistor, PN3687, Field Effect	6-112894
D101,102,105 thru 112,201	Diode, 1N914, Silicon, 75PIV	5-112004
D103	Diode, 1N5059, Silicon, 200PIV	5-113826
D104	Diode, 3N253, Bridge Rect, MDA200	6-111240
D113	Diode, 1.24V, Precision Reference	6-112221
D202	Diode, 1N5920B, Zener, 6.2 V	6-113010
MOV101 thru 105	Metal Oxide Varistor	6-110694
R101	Resistor, 1.0 k Ω , $\pm 5\%$, 3W	5-119931
R102	Resistor, Special, 20 k Ω , H.V.C.L.	6-112224
R103	Resistor, Special, 1.0 k Ω , H.V.C.L.	6-111157
R104	Resistor, Special, Attenuator	6-112780
R105	Resistor, 100 Ω $\pm .1\%$, ¼ W	6-111153
R106	Resistor, 900 Ω , $\pm .25\%$, ¼ W	5-116273
R107	Resistor, 90.0 Ω , $\pm .25\%$, ¼ W	5-116272
R108	Resistor, 9.0 Ω , $\pm .5\%$, 1W	5-118410
R109	Resistor, 0.90 Ω + 0.09 Ω , $\pm 5\%$	6-113011
R110	Resistor, 0.01 Ω , $\pm .5\%$	6-112829
R111 thru 113,116, 123,136 thru 139	Resistor, 1.0 M Ω , $\pm 5\%$, ¼ W	5-118305
R114	Resistor, 1.0 M Ω , $\pm 5\%$, 1W	6-111248
R115,117,119,126, 131,207	Resistor, 100 k Ω , $\pm 5\%$, ¼ W	5-118168
R118	Jumper	6-112837
R121,122,146	Resistor, 10 M Ω , $\pm 5\%$, ¼ W	5-116632
R124	Resistor, 4.75 k Ω , $\pm 1\%$, ¼ W	5-115954
R125	Resistor, 8.2 k Ω , $\pm 5\%$, ¼ W	5-114977
R127	Potentiometer, 1.0 k Ω , $\pm 20\%$, ½ W	5-118079
R128	Resistor, 9.31 k Ω , $\pm 1\%$, ¼ W	5-117332
R129	Potentiometer, 100 Ω , $\pm 20\%$, ½ W	5-119044
R130	Resistor, 442 Ω , $\pm 1\%$, ¼ W	5-113917
R132	Resistor, 100 k Ω , $\pm 1\%$, ¼ W	5-115506

Service Information

<u>Reference Symbol</u>	<u>Description</u>	<u>Part No.</u>
R133	Resistor, 243 k Ω , $\pm 5\%$, $\frac{1}{4}$ W	5-119708
R134,135	Resistor, 240 k Ω , $\pm 5\%$, $\frac{1}{4}$ W	6-111224
R140	Resistor, 169 k Ω , $\pm 1\%$, $\frac{1}{4}$ W	5-117525
R141	Potentiometer, 5.0 k Ω , $\pm 20\%$, $\frac{1}{2}$ W	5-118080
R142	Resistor, 16.9 k Ω , $\pm 1\%$, $\frac{1}{4}$ W	6-112240
R143	Potentiometer, 10 k Ω , $\pm 20\%$, $\frac{1}{2}$ W	5-118081
R144	Resistor, 41.2 k Ω , $\pm 1\%$, $\frac{1}{4}$ W	5-114442
R145,201	Resistor, 47 k Ω , $\pm 5\%$, $\frac{1}{4}$ W	5-114980
R202,203	Resistor, 1.0 k Ω , $\pm 5\%$, $\frac{1}{4}$ W	5-118155
R204	Resistor, 180 k Ω , $\pm 5\%$, $\frac{1}{4}$ W	5-116633
R205	Resistor, 1.8 M Ω , $\pm 5\%$, $\frac{1}{4}$ W	6-113061
R206	Resistor, 200 k Ω , $\pm 5\%$, $\frac{1}{4}$ W	6-110845
R208,209,210	Resistor, 1.5 k Ω , $\pm 5\%$, $\frac{1}{4}$ W	5-113872
R301	Resistor, 20 Ω , $\pm 5\%$, 1 W	6-110123
C101	Capacitor, 2.2 pF, $\pm 10\%$, 1 kV	5-114987
C102	Capacitor, trimmer, 5.5-60 pF	5-116235
C103	Capacitor, 180 pF, $\pm 10\%$, 50 V	6-111944
C104	Capacitor, 2500 pF, $\pm 20\%$, 1 kV	5-113985
C105	Capacitor, 0.047 μ F, $\pm 10\%$, 630 V	6-111599
C106,107,212,213, 214	Capacitor, 0.1 μ F, $-20 + 80\%$, 50 V	5-119660
C108	Capacitor, 15 μ F, $-20 + 50\%$, 16 V	5-115534
C109	Capacitor, 2.2 μ F, $\pm 10\%$, 16 V	5-115533
C110,211	Capacitor, 470 pF, $\pm 5\%$, 250 V	5-118406
C112	Capacitor, 100 μ F, 10 V	5-117206
C113,114,115, 202,203	Capacitor, 15 μ F, 16 V, Electrolytic	6-113031
C201	Capacitor, 1000 μ F, 10 V, Electrolytic	6-113015
C204	Capacitor, 220 μ F, 10 V, Electrolytic	5-117738
C205	Capacitor, 50 pF, $\pm 5\%$, 1 kV	5-117043
C206,209,215	Capacitor, 0.47 μ F, $\pm 5\%$, 100 V	6-110992
C207	Capacitor, 100 pF, $\pm 10\%$, 1 kV	5-113217
C208	Capacitor, 0.047 μ F, $\pm 10\%$, 160 V	6-113012
C210	Capacitor, 0.1 μ F, $\pm 5\%$, 100 V	5-119495
	Transducer, Audio, Piezo Ceramic	6-113019
F301	Fuse, 3 A, 600 V, BBS	6-110906
F201,302	Fuse, 2 A, 250 V, 3AG	1-112911

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